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GB 2295476 A WO 97/04421 A1 WO 95/14909 A1
WO 95/14908 A1 WO 94/28514 A1 US 5490079 A

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(54) Abstract Title
Data processing device for use in a vehicle

(57) A data processing device 1 for use in a vehicle comprising positioning means 2, 4, 5 for determining the location of the vehicle on a prestored geographical map. The positioning means 2, 4, 5 also provides information on the exact time. On the basis of this positional and temporal information, the movement of the vehicle is calculated and monitored. The thus monitored data can be used for several applications, as for example road toll calculation, or calculation of vehicle speed.

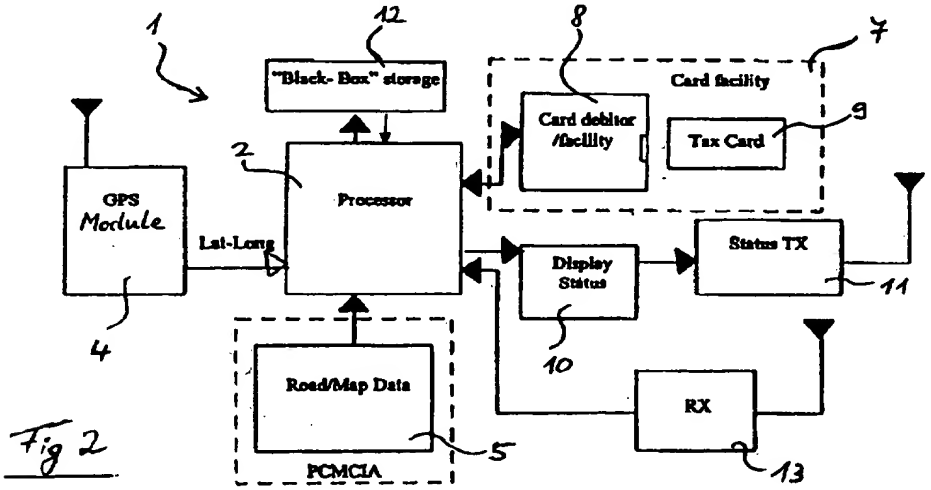

Fig 2

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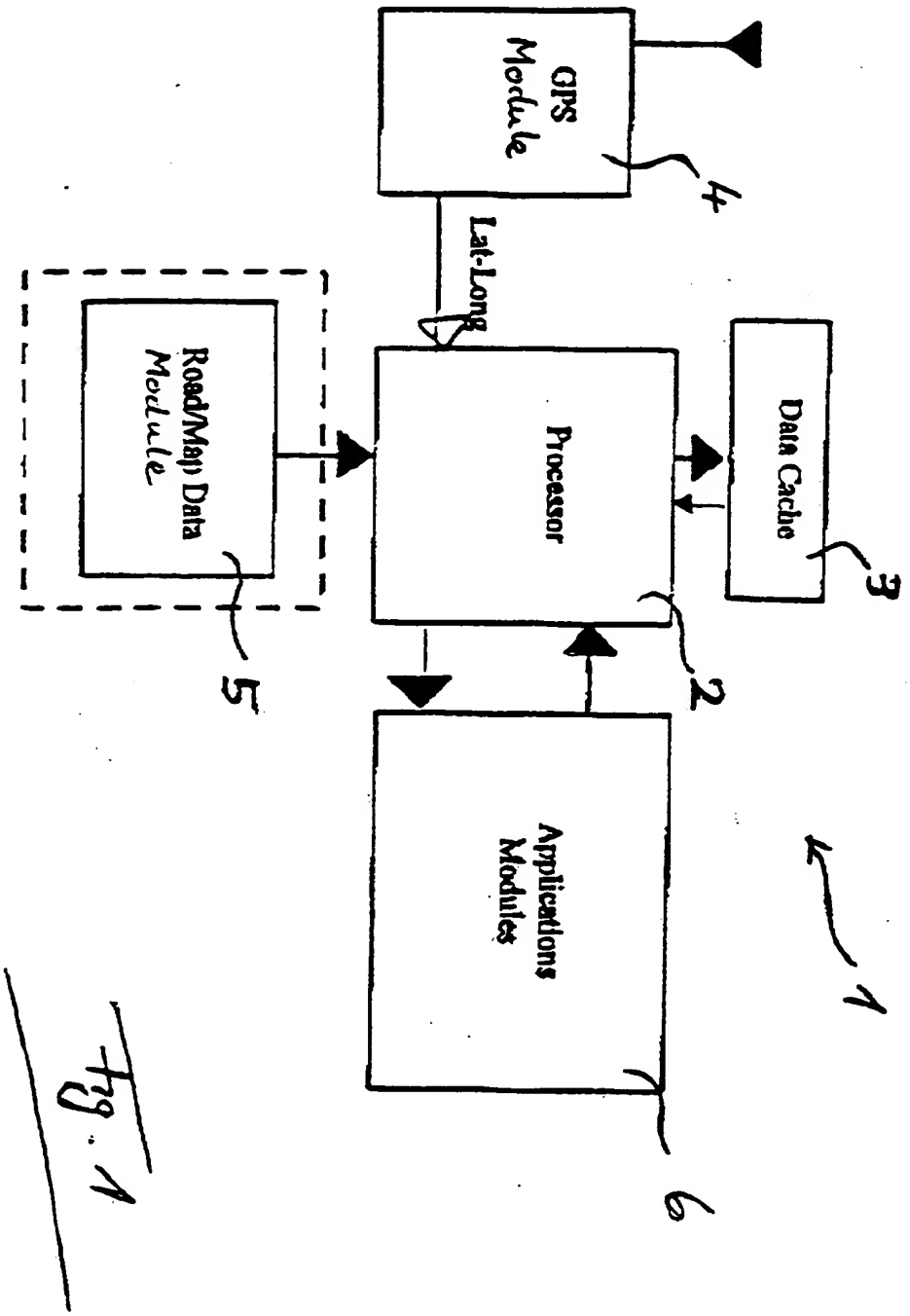
GPS Module
4
Lat-Long
Road/Map Data Module
5
Processor
2
Data Cache
3
Applications Modules
6
1

Fig. 1

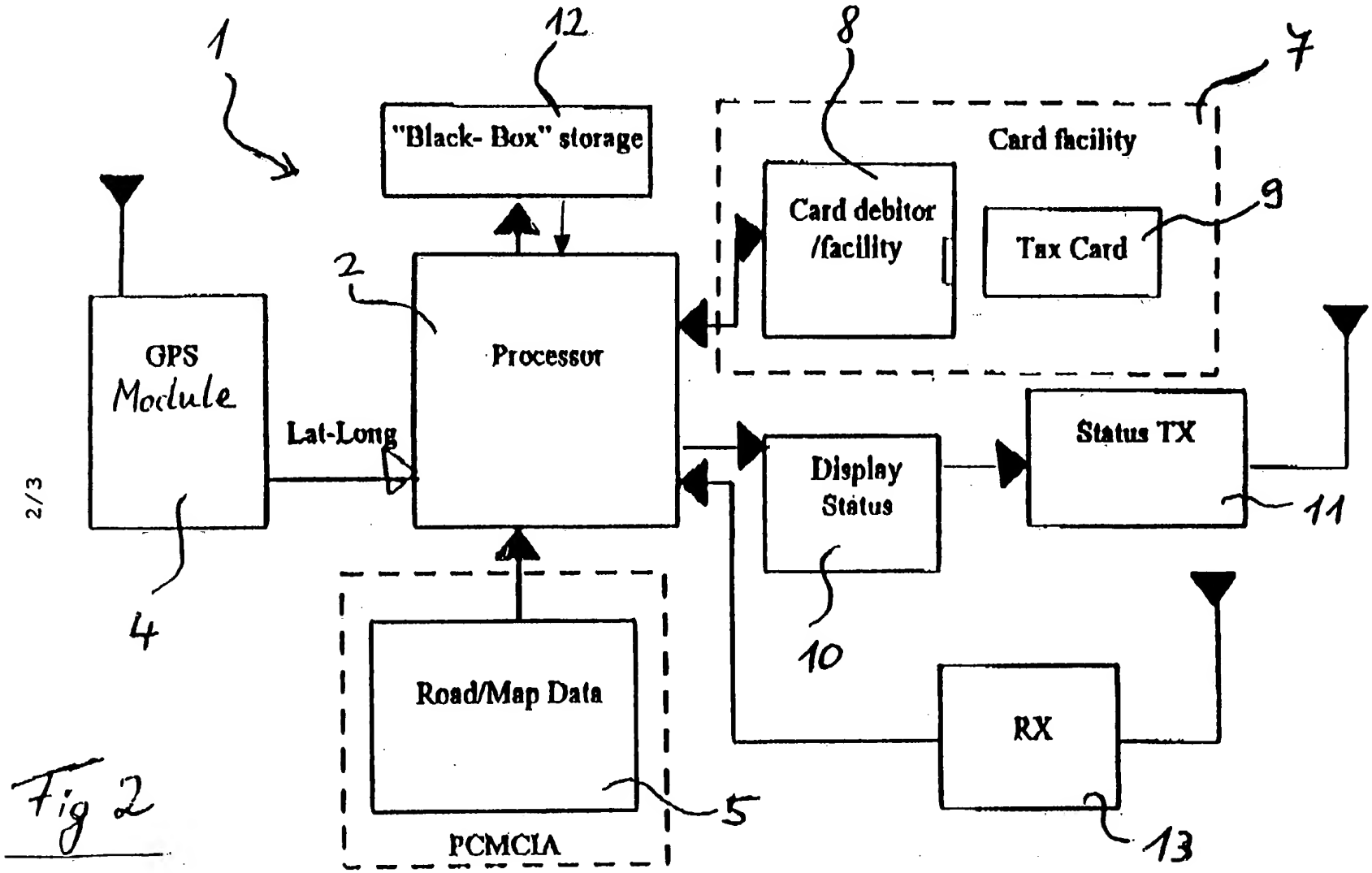
1
12
"Black- Box" storage
8
7
Card facility
Card debitor /facility
9
Tax Card
2
Processor
GPS Module
Lat-Long
Display Status
Status TX
11
4
10
Road/Map Data
RX
5
13
PCMCIA

Fig 2

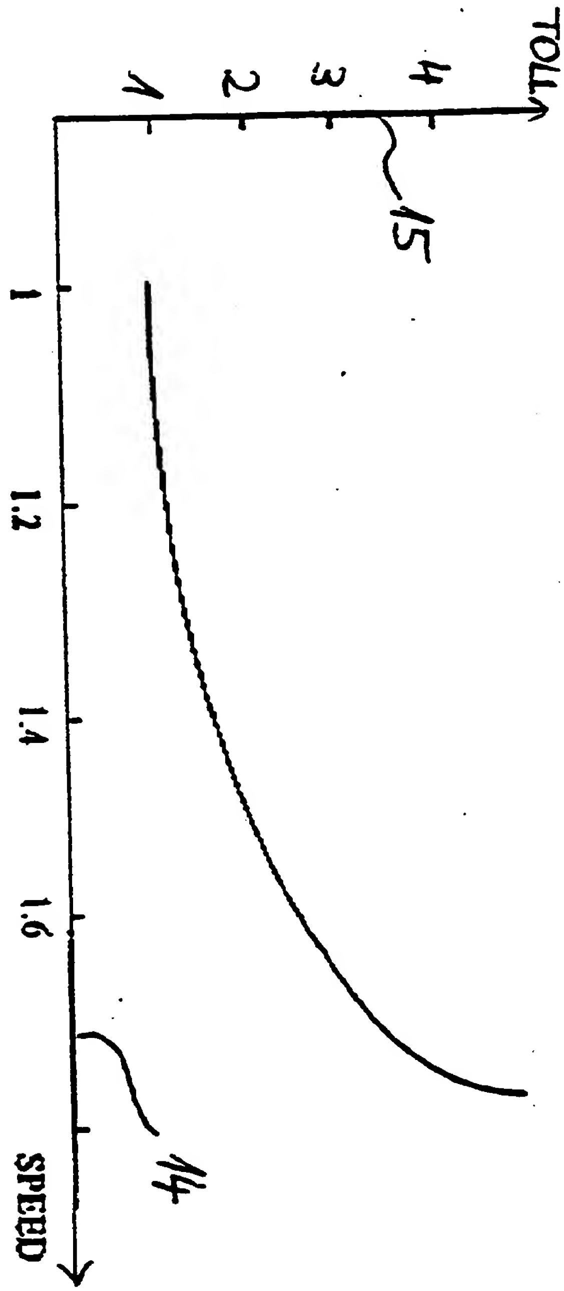

Fig. 3

A DATA PROCESSING DEVICE FOR USE IN A VEHICLE

The invention relates to a data processing device for use in a vehicle. More particularly, the invention relates to a data processing device for use in a vehicle in implementing an application specific function.

The usage of motor vehicles around the world is increasing at an alarming rate. Some of the major problems associated with the increased motor vehicle usage are environmental damage and congestion as well as safety. The current road tax system is not practical and incapable to address the above problems. For example, it does not take into consideration the amount of use of a vehicle nor does it consider where and when a vehicle is used. Users are charged the same rate regardless of how much they contribute to the above problems. For example, some users use their motor vehicles mainly over short distances on minor roads, whilst others travel long distances on main roads. In addition, some users use the roads on peak time while others do not.

Currently, as for example in the UK road tax discs can be obtained from the post office by filling in an application form. Hence, there is a considerable requirement for human resources which causes high expenses. There is also a requirement for additional human resources to monitor whether a road tax disc is displayed on the windscreen of a car and whether a displayed

road tax disc is valid. This either causes high expenses or, if the requirement for sufficient human resources to enforce the law is not fulfilled, makes it possible for individuals to avoid obtaining a road tax disc for some time or in some cases not to obtain it at all, which clearly causes a reduction in government revenues. This in turn can cause the appropriate authority to increase the road tax charge in general in order to compensate for the loss in revenue in the above mentioned cases.

While the current tax collection method needs to be reconsidered by the corresponding authorities, it is desired to provide a data processing device for use in a vehicle that monitors the movement and thus the actual use of a vehicle. The present invention aims to provide such a data processing device which can implement various application specific functions in order to address at least some of the above mentioned and associated problems.

According to one aspect of the invention, there is provided a data processing device for use in a vehicle in implementing an application specific function for example road tax collection, the device comprising positioning means for determining the current location of the device on a geographical map; and a data memory for storing the current map location determined by the positioning means; wherein the device is arranged to monitor movement of the vehicle over a predetermined time period by repeatedly determining the position of the device during the time period and repeatedly storing the map

location in the memory for use by the application specific function.

Preferably, the position of the device is determined at regular time intervals, thereby to calculate the speed of the vehicle. The data memory is arranged to store the calculated speed of the vehicle. Thus, not only the location of the vehicle but also the vehicle's speed can be monitored without using the vehicle's built-in speed sensors.

The data memory can be arranged to accumulate a series of map locations and corresponding vehicle speeds for recording the movement of the vehicle over the time period. Accordingly, a history of the movement of the vehicle can be obtained.

In an embodiment of the invention, the positioning means comprises receiving means being receptive to a signal from an external transmitter which is representative of the current geographical coordinates of the vehicle. For example, the receiving means can comprise a Global Positioning System (GPS). The GPS system provides an exact and reliable positioning on the Earth's surface. Thereby, the device is not restricted to be used only in limited areas of the world. The positioning means comprises mapping means which can utilise the current geographical coordinates provided by the receiving means to identify the current location of the device on the geographical map. Preferably, the mapping means comprises a portable store for storing the geographical map and means for reading the geographical map

from the portable store when the current location of the device is to be determined. Accordingly, any desired geographical map can be used by simply exchanging the portable store, as can be necessary for example when travelling to different countries. Preferably, the mapping means comprises a Geographical Information System (GIS), and the portable store is based on a PCMCIA (Personal Computer Memory Card International Association) standard.

In another embodiment of the present invention, the device further comprises a low power transmitter for transmitting locally a signal representative of the identity of the device. Preferably, the low power transmitter further transmits a signal representative of the speed of the vehicle. Accordingly, the signal transmitted by the low power transmitter can be received by local receivers in order to carry out vehicle identification or speed monitoring.

In another embodiment of the invention, the device further comprises a road information store for storing a classification of the various categories of roads of the geographical map. The road information store further stores various tolls associated with the various categories of roads, whereby the application specific function can determine the specific toll payable by use of any road of the geographical map. Thus, on the basis of the information on the movement of the vehicle, different tolls can be set for various kinds of

roads so that a user of the vehicle has to pay tolls for the use of only the roads that he/she actually has used. Preferably, the road information store comprises a portable store, whereby different portable stores can be used interchangeably for different toll systems of various countries.

The road information store further can store time and/or date variable tolls for each category of road. The road information store can also store speed limits associated with each category of road and various tolls associated with the speed of the vehicle when the vehicle's speed exceeds a speed limit. Accordingly, tolls can not only be imposed on the use of different categories of roads but also in relation to the time and/or date when a particular road is used. In addition, additional tolls can be imposed when a user of the vehicle is exceeding the existing speed limits.

In another embodiment of the present invention, the device further comprises a portable debit/credit store for storing a debit/credit status, and means for reading and/or updating the debit/credit status, wherein the debit/credit status can be updated when the particular toll is payable. Thus, any payable toll can be automatically charged to the debit/credit store. The portable debit/credit store can be replaced in the case that a credit on the debit/credit store is used up. The road information store and the debit/credit store can be provided on a single portable memory card. In that case, a user only has to obtain one single smart card when he travels to another country where

a different toll system applies and the remaining credit on the debit/credit store may not be sufficient.

Preferably, the device also comprises display means for indicating the debit/credit status to the user of the vehicle. Thereby, a user is informed of the level of his credit and is not caught by surprise when his credit has expired.

The low power transmitter can also transmit a signal representative of the debit/credit status. It is thereby possible for an enforcement agency to monitor that all road users, local or not, actually pay for the use of the roads.

The data memory can further store an insurance status of the vehicle and/or a user of the vehicle and/or an MOT status of the vehicle. In addition, the device can comprise a portable vehicle information store for storing an updated MOT status of the vehicle and/or an updated insurance status of the vehicle and/or a user of the vehicle, wherein the portable vehicle information store can be used for updating the insurance status and the MOT status in the data memory. The low power transmitter can then also be used for transmitting a signal representative of the insurance status and/or the MOT status. Accordingly, the device also allows the appropriate authority to monitor that all users have valid insurance and MOT certificates.

In another embodiment of the invention, the system further comprises reception means for receiving from an external radio transmitter a signal

representative of an additional toll associated with a specific road, and/or a signal representative of a temporary speed limit associated with a predetermined section of a road and various tolls associated with the speed of the vehicle when the vehicle's speed exceeds the temporary speed limit. Accordingly, additional tolls can be imposed on the use of specific roads as for example bridges or tunnels, and also when a user does not keep to a temporary speed limit due to traffic conditions, weather conditions, etc.

In another embodiment of the invention, the device further comprises a long range transmitter for transmitting a signal representative of the map location of the device. By employing an external receiver to receive this transmitted signal, the location and movement of the vehicle can be monitored over a large area. This information can be used for example for fleet management, vehicle and road use monitoring, etc.

According to another aspect of the invention, there is provided a method of processing data in a vehicle for implementing an application specific function, the method comprising determining the current location of the device on a geographical map; storing the determined current map location in a data memory; monitoring the movement of the vehicle over a predetermined time period by repeatedly determining the position of the device during the time period and repeatedly storing the map location in the memory for use by the application specific function.

According to another aspect of the invention, there is provided a data processing apparatus for a vehicle, the apparatus comprising means for obtaining positional information regarding the current location of the apparatus; means for obtaining temporal information in relation to the positional information; and means for monitoring the positional and the temporal information in order to carry out a data processing function on the basis of the monitored information.

The above and further features of the invention are set forth with particularity in the appended claims and together with advantages thereof will become clearer from consideration of the following detailed description of an exemplary embodiment of the invention given with reference to the accompanying drawings.

In the drawings:

Figure 1 is a schematic block diagram of a data processing device for use in a vehicle embodying the invention;

Figure 2 is a further schematic block diagram of the data processing device of Figure 1 showing exemplary application modules; and

Figure 3 is a diagram showing the amount of toll to be paid depending on the degree to which a speed limit is exceeded.

Turning now to Figure 1 of the accompanying drawings, there is shown in a vehicle data processing device 1 comprising a processor 2 which is linked

to a data cache 3. The processor 2 is also linked to a GPS module 4 (Global Positioning System). The GPS module 4 provides a position fix of the vehicle in which the data processing system 1 is installed on the Earth's surface. The GPS module 4 receives a signal from a satellite system (not shown) identifying the position of the vehicle. The GPS module 4 transfers latitude and longitude coordinate data representing the device's geographical position to the processor 2. The processor 2 retrieves road map data from a road map data module 5. The road map data module 5 is an electronic mapping device which is based on a PCMCIA (Personal Computer Memory Card International Association) standard and which is sometimes referred to as Geographical Information System (GIS). The road map data module has a data store (not shown) on which a road map of a specific area, for example the UK, is stored. For example, the road map data module 5 can comprise a compact disc drive (CD-drive) with the road map stored in the data store namely a CD. The required road map can thus be made available to the system 1 by simply inserting the desired CD into the CD drive.

Once the processor 2 has retrieved the required road map data from the road map data module 5, a mapping algorithm or correlation implemented on the processor 2 is carried out on the basis of the data from the GPS module 4 and from the road map data module 5. The correlation is carried out to identify the location of the vehicle on the stored map. This correlation is

carried out at regular short time intervals (typically 1 second) while the vehicle is moving. During these time intervals, any data required for the correlation is temporarily stored in the data cache 3.

The processor 2 sends data to and receives data from application modules 6. The application modules 6 perform specific tasks on the basis of the data generated by the processor 2. Any particular application will use the shown general configuration. The number and complexity of the applications effects the size of the data cache 3. The number and diversity of these applications are not limited. Examples of applications include pay per use road usage taxation (toll collection), road tax enforcement, vehicle identification, vehicle use monitoring, route finding, etc. Examples of these applications will be described in more detail in connection with Figure 2.

The system shown in Figure 1 can also be extended to include access to a terrestrial data network which would allow bi-directional data exchange. This would extend the above mentioned applications to fleet control, vehicle monitoring, route monitoring, etc.

Referring to Figure 2 of the accompanying drawings, the configuration of Figure 1 as previously described is shown with specific application modules. The processor 2 is connected with a toll collection module 7. The toll collection module 7 comprises a credit/debit facility 8 and a toll card 9. The credit/debit facility 8 is used by a user of the vehicle to pay a toll for

his/her usage of a road. The toll card 9 is purchased by the user for a certain amount of money. The toll card 9 contains credit information as well as information on the tolls to be paid for the usage of different categories of roads. The different categories of roads depend on the country in which the system is to be used. As an example in the UK, the categories can be classified as A-roads, B-roads, Motorways, special roads and limited access roads.

The toll card is inserted into the credit/debit facility 8. The credit/debit facility 8 reads information from the toll card 9 on the credit status of the user and the tolls to be paid for the use of a particular category of road. The credit/debit facility 8 manipulates the credit information on the toll card 9, for example when a due toll for the usage of a particular category of road has to be paid. When the vehicle is driven to another area where a different toll system is valid, for example another country, the user can simply replace the present toll card 9 with a new toll card including new toll and credit information.

As described above, the processor 2 determines the location of the vehicle, i.e. the road on which the vehicle is driven on, by means of the GPS module 4 and the road map data module 5. The processor 2 retrieves data from the toll collection module 7 in order to determine the category of road the vehicle is driven on and the toll to be paid for the usage of that category

of road. The information on the toll which is now due is sent to the credit/debit facility 8 which debits the toll card with the calculated sum. This is all carried out automatically so that all drivers (local or not) pay for the use of the roads.

In addition to the location of the vehicle, the GPS module 4 also provides an accurate time of the day and date. Therefore, different tolls can be set depending on the time and date when the vehicle is used on a particular category of road. In addition, since the location determined by the GPS module 4 is updated at short intervals, the speed of the vehicle can be determined continually. The speed limits of the different categories of roads can be provided on the toll card 9. Accordingly, extra tolls can be set if the user of the vehicle exceeds a speed limit.

The system 1 further comprises a display 10 for displaying a toll credit status based on the credit information stored on the toll card 9. This information is retrieved from the toll card 9 by the processor 2. The processor 2 determines the toll credit status and controls the display 10 in order to indicate the toll credit status. For example, the display 10 can comprise a green, a red and an orange light (LED). The green light indicates a valid credit status. The red light indicates an invalid credit status, for example in case when the tax card 9 has expired. The orange light is used to indicate a near expiry condition. All lights are switched off when the system

is faulty.

A relatively low power radio transmitter 11 is connected to the display 10. In case of an invalid credit status, the radio transmitter 11 starts transmitting a radio signal having a short range indicating the vehicle's identity and the credit status. This signal can be received by corresponding receivers which can be installed, for example, in police cars or traffic cameras installed on the streets which are currently used to enforce speed limits.

The system 1 further comprises a so-called "black box" 12 which is a data logger for storing information on the use of the vehicle over the preceding 24 hours. This information can include the locations, the time, the speeds, and other desired parameters on the use of the vehicle. This information can be retrieved and used for example by the police or an insurance company when accidents, disputes, etc. arise and clarification of the cause thereof is required. The black box 12 can also store information on an insurance status of the vehicle and/or the user(s). Also, information on the MOT status of the vehicle can be stored. The black box 12 can be updated through insurance or MOT renewal cards which can be inserted and read by the black box. The information on the insurance and/or MOT status can also be transmitted through the radio transmitter 11.

A receiver 13 is provided for receiving additional information as for example temporary speed limits due to weather or traffic conditions (e.g. fog),

road work or traffic control. Corresponding tolls to be paid are retrieved from the toll card 9 and debited in case the user exceeds a temporary speed limit.

Referring to Figure 3 of the drawings, a diagram is shown, indicating the relation between a toll to be paid in addition to the standard poll payable for the use of a particular road when a speed limit is exceeded. The "speed"-axis 14 indicates the factor by which a speed limit, indicated as "1", is exceeded. The "toll"-axis 15 indicates the factor by which standard toll, indicated as "1", is increased depending on the speed of a driver. It is possible to fix any desired relation between the speed and the due toll.

Having thus described the present invention by reference to a preferred embodiment it is to be well understood that the embodiment in question is exemplary only and that modifications and variations as will occur to those possessed of the appropriate knowledge and skills may be made without departure from the spirit and scope of the invention as set forth in the appended claims and equivalents thereof. For example, the device can also comprise further long range transmission means for transmitting data on the use of the vehicle, as for example information on which roads are used or when the vehicle is used. It is thereby possible to monitor vehicles and roads, which in turn can be used to gain information for traffic control. In addition, the device can also comprise further long range reception means for receiving information on traffic or weather conditions, road works, etc. Thereby, the

system can also be used for fleet management, for example in forwarding agencies. Furthermore, the device can also be used to reward a driver rather than to impose additional tolls. For example, a driver's toll can be decreased when he/she has driven well over a period of time and can thus be used to encourage careful driving.

CLAIMS:

1. A data processing device for use in a vehicle in implementing an application specific function, the device comprising:

positioning means for determining the current location of the device on a geographical map; and

a data memory for storing the current map location determined by the positioning means;

wherein the device is arranged to monitor movement of the vehicle over a predetermined time period by repeatedly determining the position of the device during the time period and repeatedly storing the map location in the memory for use by the application specific function.

2. The device of claim 1, wherein the position of the device is determined at regular time intervals thereby to calculate the speed of the vehicle, and wherein the data memory is arranged to store the calculated speed of the vehicle.

3. The device of claim 1 or 2, wherein the data memory is arranged to accumulate a series of map locations and corresponding vehicle speeds for recording the movement of the vehicle over the time period.

4. The device of any preceding claim, wherein the positioning means comprises receiving means being receptive to a signal from an external transmitter, the signal being representative of the current geographical coordinates of the vehicle.

5. The device of claim 4, wherein the receiving means comprises a Global Positioning System (GPS).

6. The device of any of claims 4 or 5, wherein the positioning means comprises mapping means which can utilise the current geographical coordinates provided by the receiving means to identify the current location of the device on the geographical map.

7. The device of claim 6, wherein the mapping means comprises a portable store for storing the geographical map and means for reading the geographical map from the portable store when the current location of the device is to be determined.

8. The device of claim 6 or 7, wherein the mapping means comprises a Geographical Information System (GIS).

9. The device of any of claims 7 or 8, wherein the portable store is based on a PCMCIA (Personal Computer Memory Card International Association) standard.

10. The device of any preceding claim, further comprising a low power transmitter for transmitting locally a signal representative of the identity of the device.

11. The device of claim 10, wherein the low power transmitter further transmits a signal representative of the speed of the vehicle.

12. The device of any preceding claim, further comprising a road information store for storing a classification of the various categories of roads of the geographical map, the road information store further storing various tolls associated with the various categories of roads, whereby the application specific function can determine the specific toll payable by use of any road of the geographical map.

13. The device of claim 12, wherein the road information store comprises a portable store, whereby different portable stores can be used interchangeably for different toll systems of various countries.

14. The device of claim 12 or 13, wherein the road information store further stores time and/or date variable tolls for each category of road.

15. The device of any of claims 12 to 14, wherein the road information store further stores speed limits associated with each category of road and various tolls associated with the speed of the vehicle when the vehicle's speed exceeds a speed limit.

16. The device of any of claims 12 to 15, further comprising a portable debit/credit store for storing a debit/credit status, and means for reading and/or updating the debit/credit status, wherein the debit/credit status can be updated when the particular toll is payable.

17. The device of claim 16, wherein the road information store and the debit/credit store are provided on a single portable memory card.

18. The device of claim 16 or 17, further comprising display means for indicating the debit/credit status to the user of the vehicle.

19. The device of any of claims 16 to 18 as dependent on any of claims 10 to 15, wherein the low power transmitter further transmits a signal

representative of the debit/credit status.

20. The device of any preceding claim, wherein the data memory further stores an insurance status of the vehicle and/or a user of the vehicle and/or MOT status of the vehicle.

21. The device of claim 20, further comprising a portable vehicle information store for storing an updated MOT status of the vehicle and/or an updated insurance status of the vehicle and/or a user of the vehicle, wherein the portable vehicle information store can be used for updating the insurance status and/or the MOT status in the data memory.

22. The device of claim 20 or 21 as dependent on any of claims 10 to 19, wherein the low power transmitter further transmits a signal representative of the insurance status and/or the MOT status.

23. The device of any preceding claim, further comprising reception means for receiving from an external radio transmitter a signal representative of an additional toll associated with a specific road, and/or a signal representative of a temporary speed limit associated with a predetermined section of a road and various tolls associated with the speed of the vehicle

when the vehicle's speed exceeds the temporary speed limit.

24. The device of any preceding claim, further comprising a long range transmitter for transmitting a signal representative of the map location of the device.

25. A method of processing data in a vehicle for implementing an application specific function, the method comprising:

determining the current location of the device on a geographical map;

storing the determined current map location in a data memory;

monitoring the movement of the vehicle over a predetermined time period by repeatedly determining the position of the device during the time period and repeatedly storing the map location in the memory for use by the application specific function.

26. A data processing apparatus for a vehicle, the apparatus comprising:

means for obtaining positional information regarding the current location of the apparatus;

means for obtaining temporal information in relation to the positional information; and

means for monitoring the positional and the temporal information in order to carry out a data processing function on the basis of the monitored information.

27. A data processing device or method substantially as described herein with reference to the accompanying drawings.

The Patent Office

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Application No:	GB 9711342.7	**Examiner:**	Geoff Nicholls
Claims searched:	All	**Date of search:**	11 July 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4T (TAF TAX)

Int Cl (Ed.6): G07B 15/00 15/02

Other: ONLINE:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2295476 A	(AZTECH SYSTEMS) Whole document	1, 4, 5, 12, 14, 16, 18, 25, 26
X	WO 97/04421 A1	(D & E CONSULTING) See especially Page 14 lines 15 to 30	1, 4 to 7, 10, 12, 14, 25, 26
X	WO 95/14909 A1	(MANNESMANN) Whole document	1 4 to 6, 12, 25, 26
X	WO 95/14908 A1	(MANNESMANN) Whole document	1, 4 to 6, 12, 25, 26
X	WO 94/28514 A1	(MANNESMANN) Whole document	1, 4 to 6, 12, 25, 26
X	US 5490079	(SHARPE) See especially Column 3 lines 12 to 17	1, 4, 5, 10, 25, 26

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.